Nearshore Wave Prediction System (NWPS): On-demand Coastal Wave Model Guidance

André van der Westhuysen, Roberto Padilla, Hendrik Tolman (NCEP)

Nicole Kurkowski (OST); John Kuhn (OCWWS);

Pablo Santos, Alex Gibbs, Joe Maloney (WFO-MFL), Doug Gaer, Jack Settelmaier (SRH); Troy Nicolini, Sten Tjaden, Brian Garcia (WFO-EKA); Ray Ball (WFO-MOB); Donnie King, Scott Kennedy (WFO-MHX), Carlos Anselmi (WFO-SJU), Eric Lau (PRH), Carl Dierking (WFO-JUN), Jim Nelson (WFO-ARH)

Jeffrey Hansson (USACE/CHL), Eve-Marie Devaliere (NESDIS/STAR), Joe Long and Hilary Stockdon (USGS)

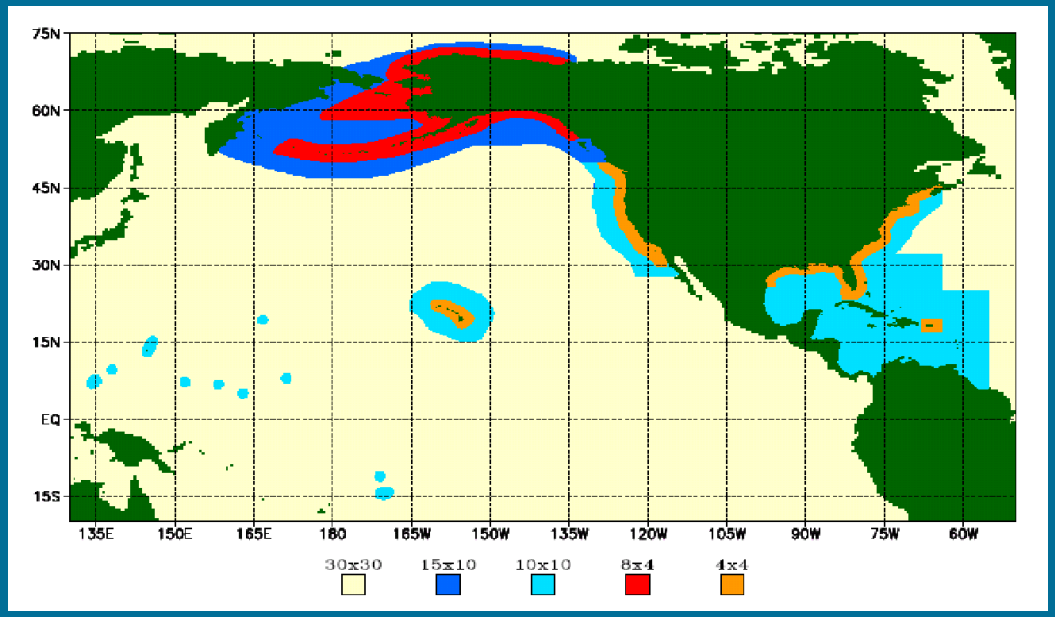
NCEP Science Quarterly, April 20, 2015

Outline

1. Need for nearshore wave guidance
2. NWPS system design
3. Input, output and data flow
4. System loading and Validation
5. Implementation schedule
6. Future apps: Rip currents and wave run-up

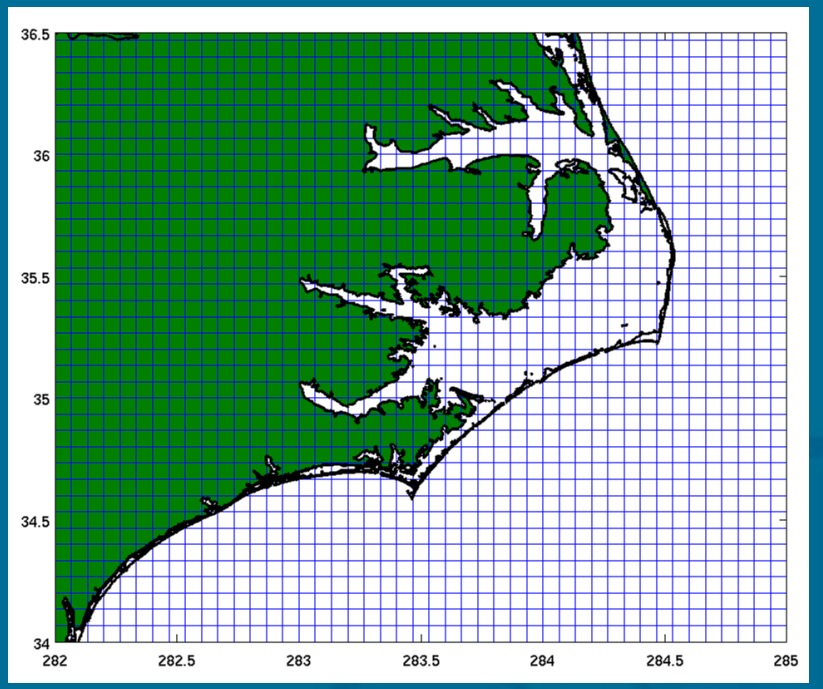
NCEP Wave guidance products

WAVEWATCH 3 global grid mosaic



- *Max. coastal resolution = 4 arc-min (7.5 km)*
- *Forced by GFS*

Nearshore downscaling



- *Req. resolution = 500 m - 1.85 km*
- *Forecaster wind fields (GFE)*

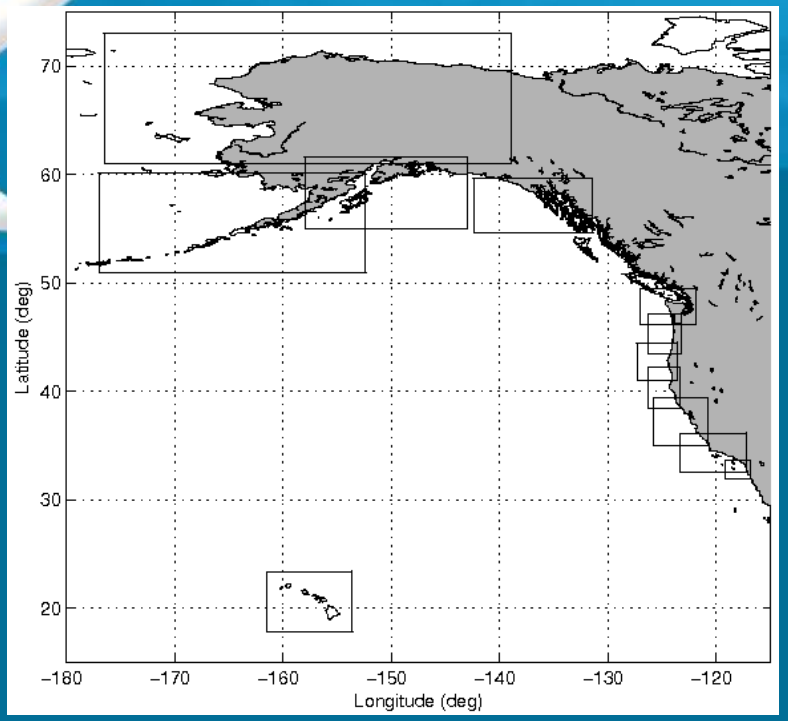
The Nearshore Wave Prediction System (NWPS)

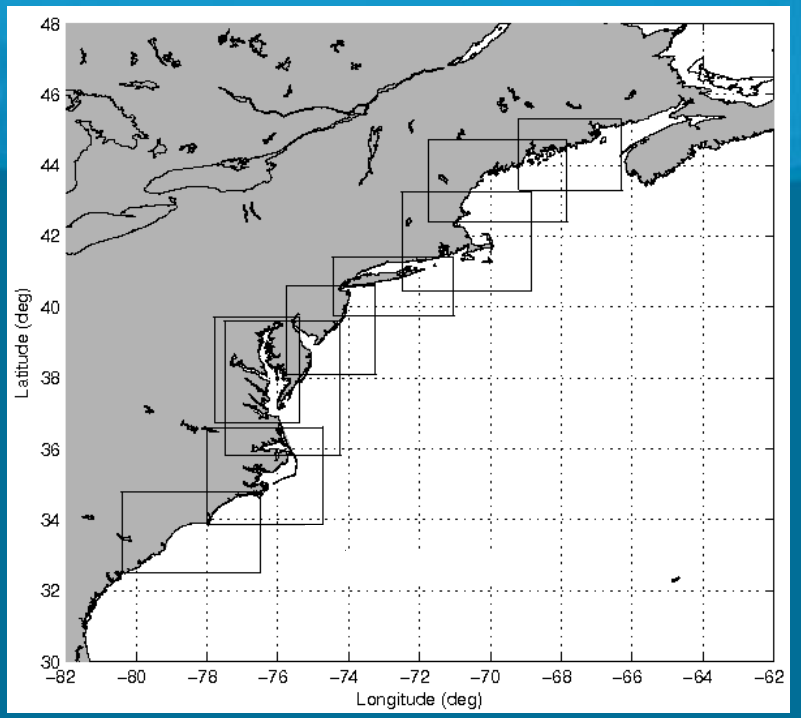
- Run on-demand, using open-source wave model SWAN.
- Driven by forecaster-developed winds from GFE (AWIPS2), and other NCEP forcings (e.g. WW3 BCs, RTOFS/ESTOFS).
- Included in the AWIPS2 baseline for sustainability.
- Addresses region-specific physical processes in the nearshore (wave-current interaction, ice interaction, vegetation, etc.).
- Includes wave partitioning (separates wave field into component systems). In future: rip current and wave run-up guidance.

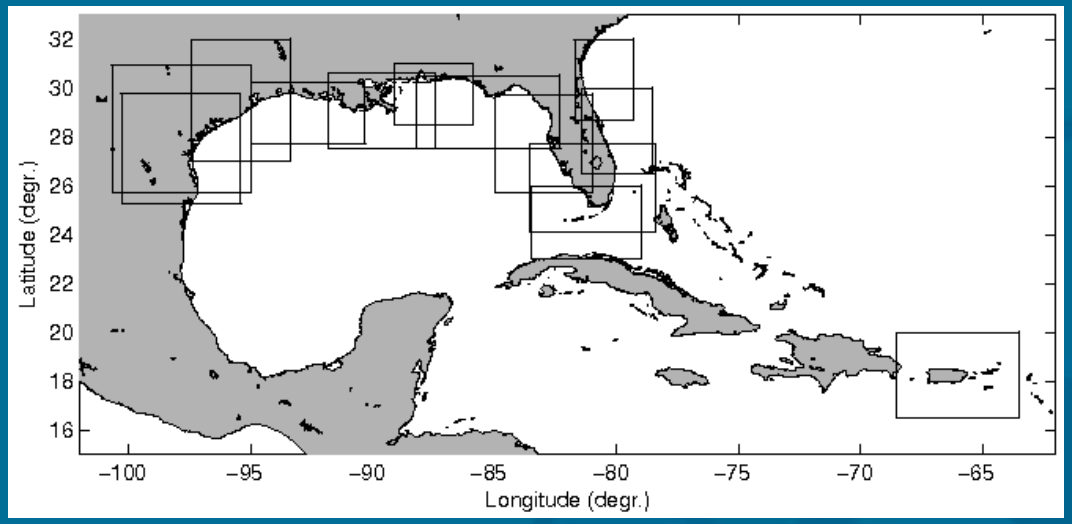
* WFO-based pilot project (WFO Eureka) transitioned to NCEP

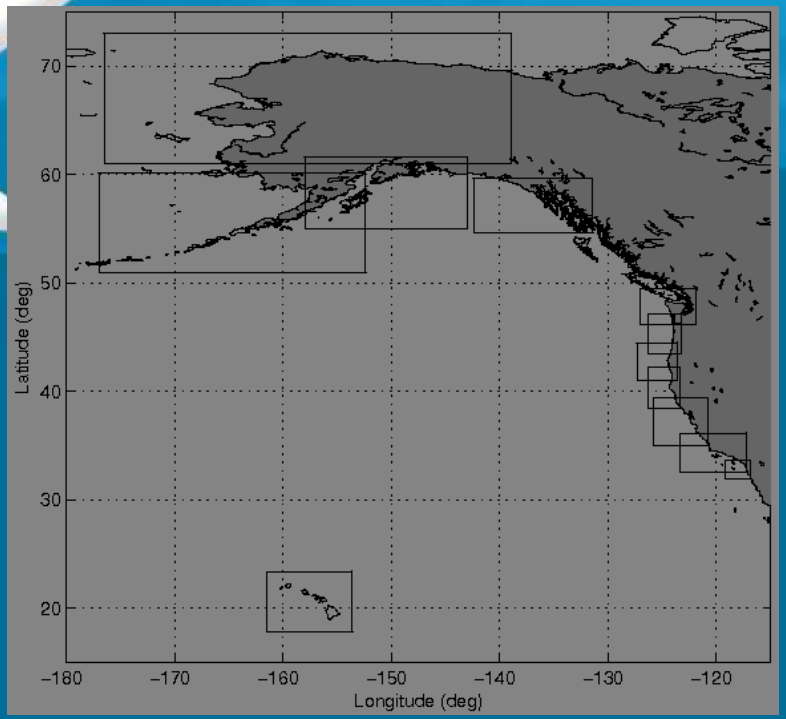
* Sandy Supplemental Milestone FY15Q4

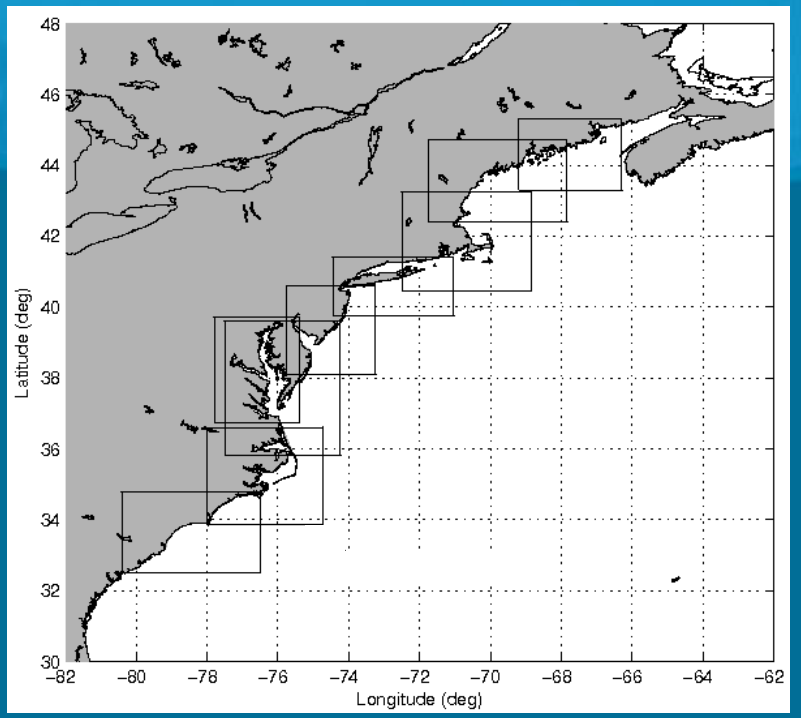
NWPS grids for coastal WFOs



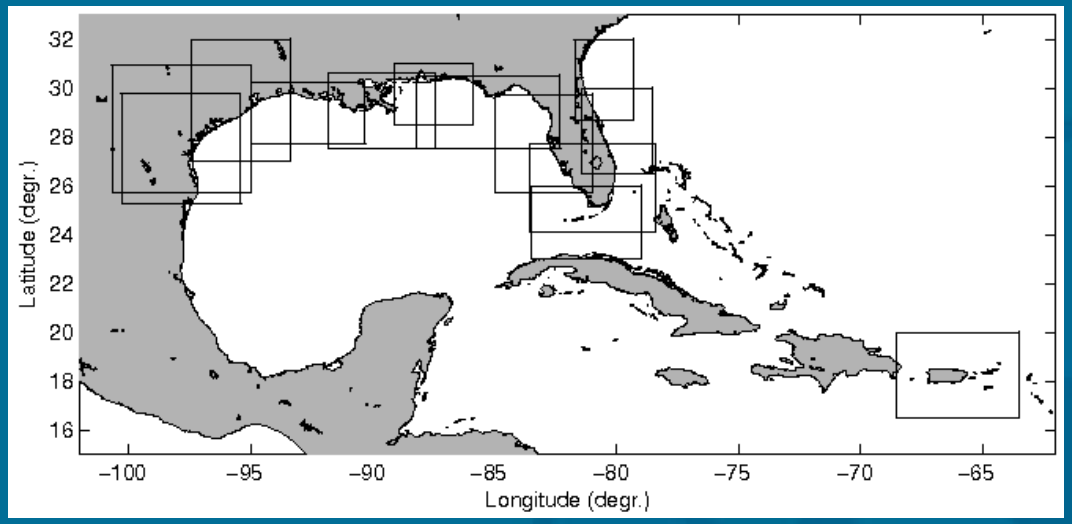




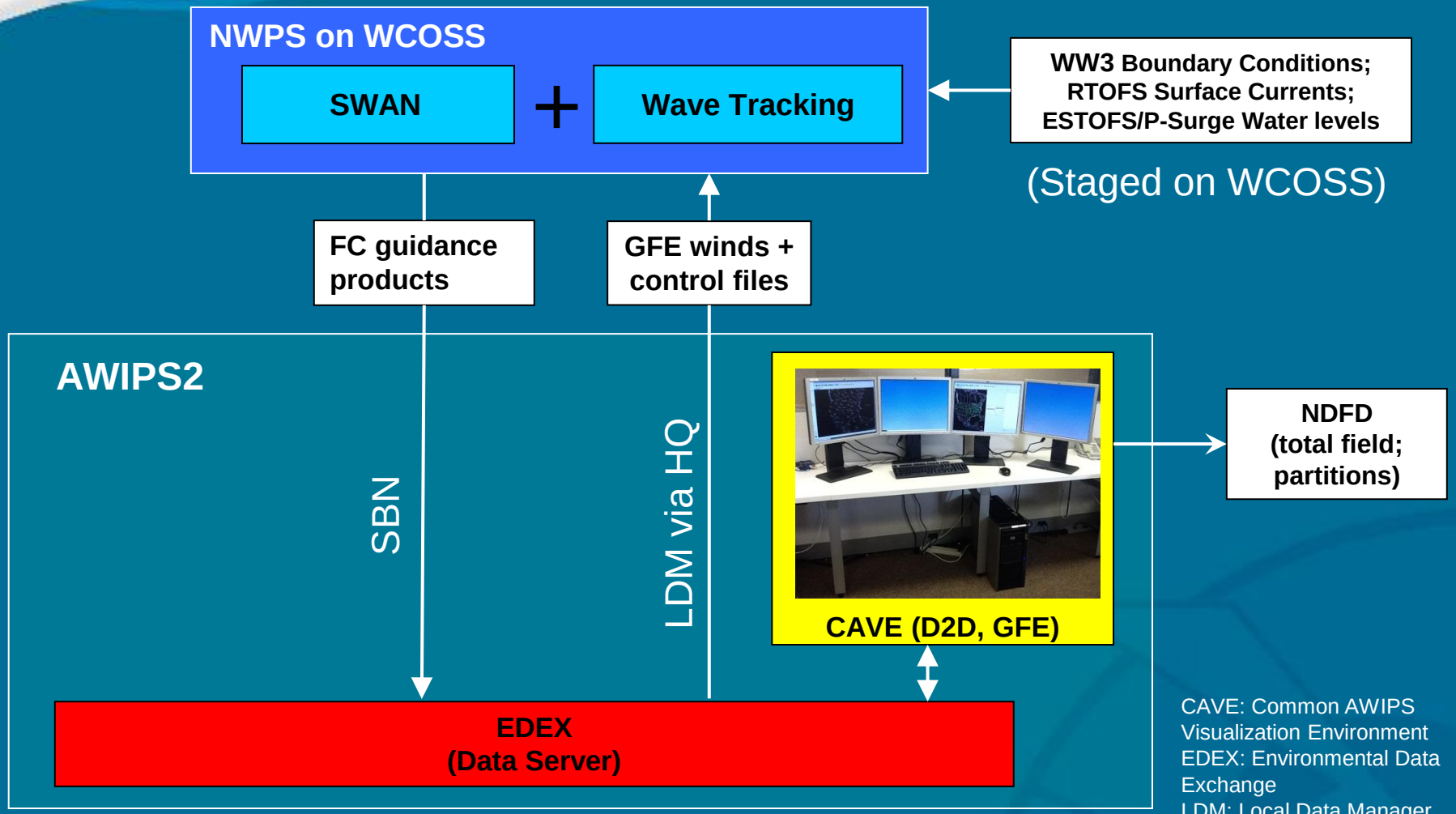




NWPS grids for coastal WFOs

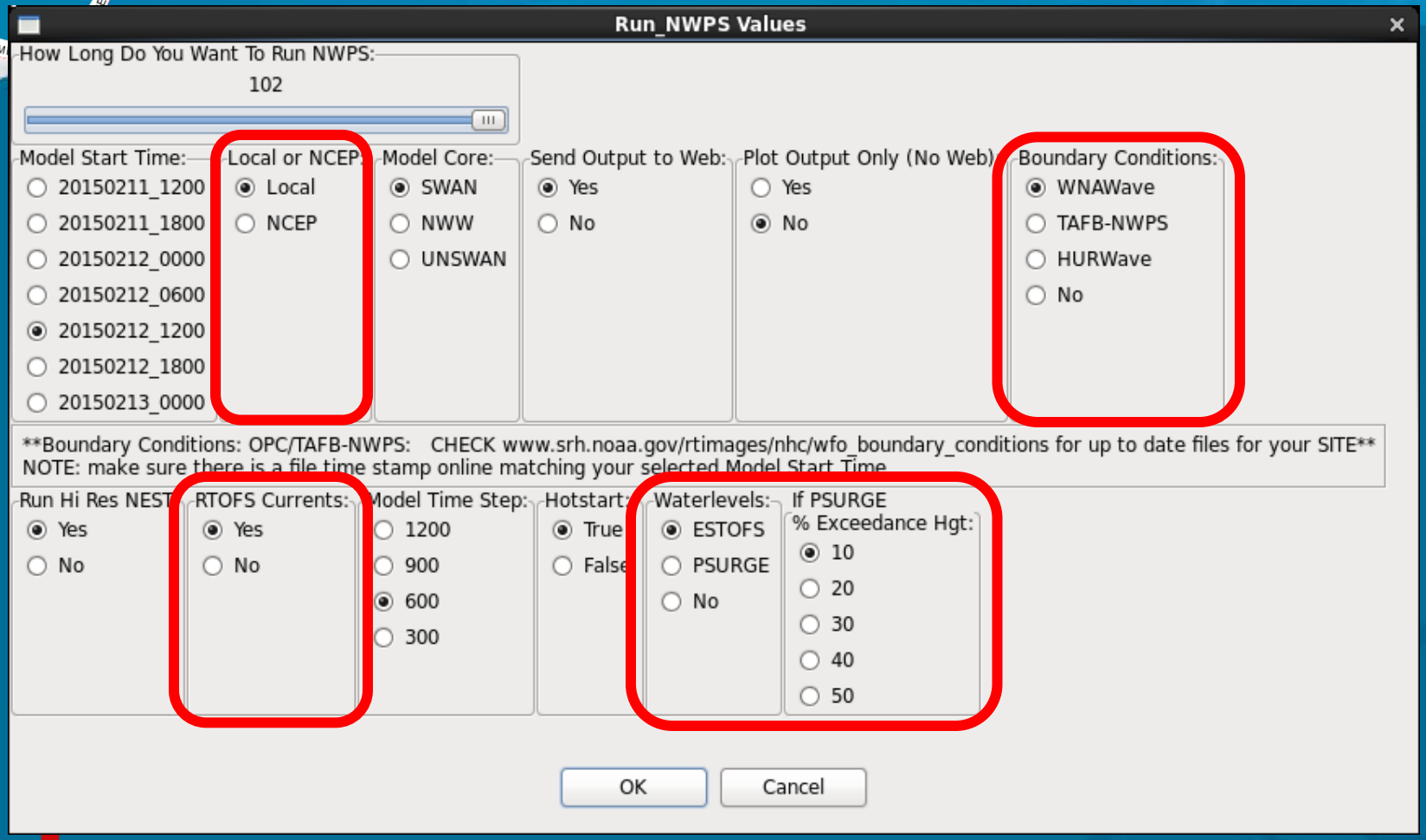


NWPS Architecture (WFO view)



CAVE: Common AWIPS Visualization Environment
EDEX: Environmental Data Exchange
LDM: Local Data Manager

NWPS User Interface (AWIPS2 v14.4.1)



GRID file (GFE winds, text file)

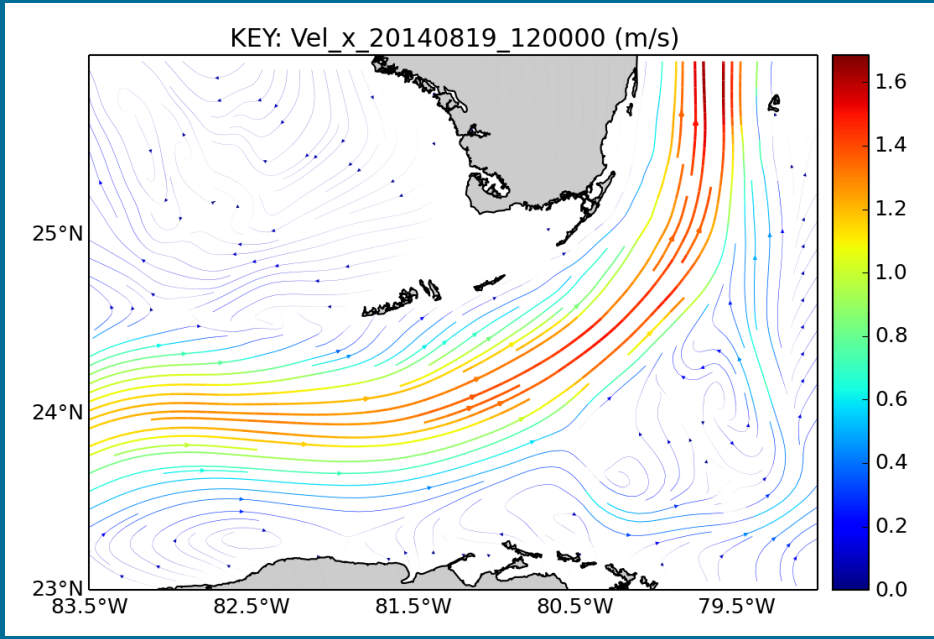
DOMAIN file (9.6 kB text file)

CONTROL file (1 kB text file)

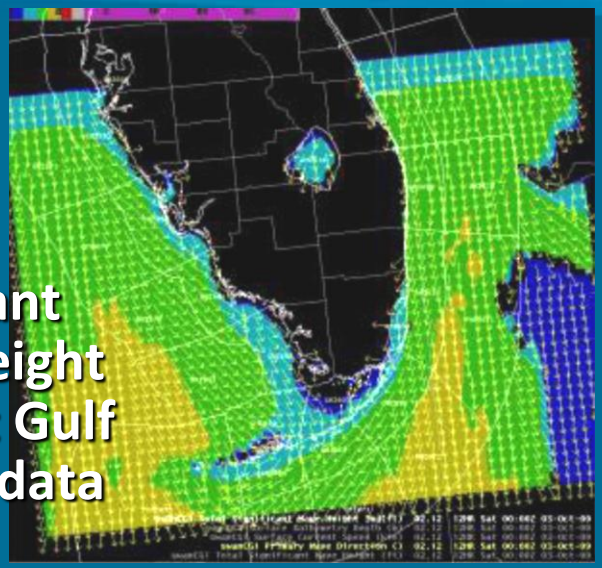
Size = ~2 Mb zipped

Forcings: Surface currents

RTOFS Global output of Gulf Stream



Significant wave height without Gulf Stream data



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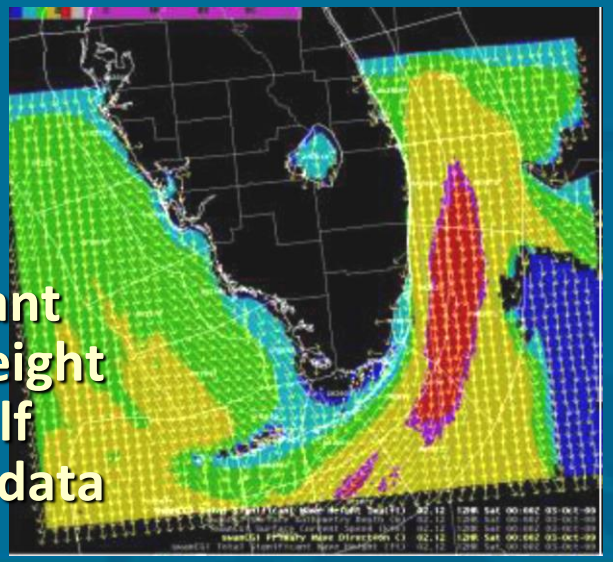


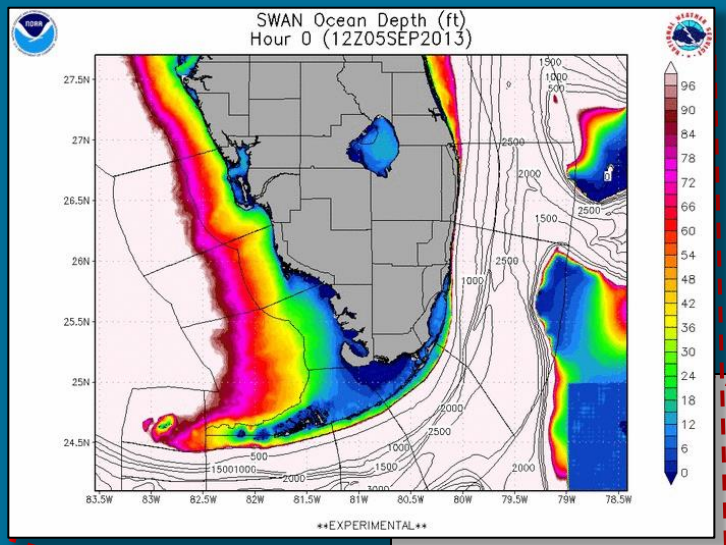
(Settelmaier et al. 2010)

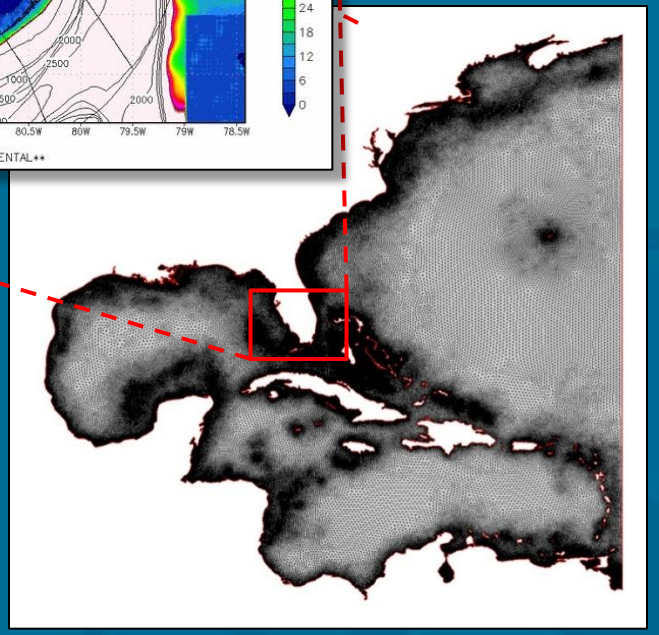
Forcings: Water levels, Extra-tropical

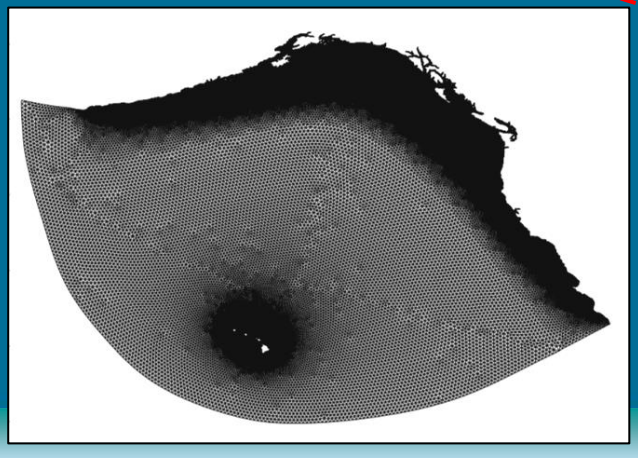
Surge & tides from ESTOFS Atlantic and Pacific

ESTOFS features:

- Single deterministic run, 4 cycles/day
- Coastal resolution ≈ 1-5 km
- Barotropic ADCIRC model
  - Tidal boundary forcing at 60º W
  - Tidal forcing from TPXO 6.2 global tide model
  - Meteorological forcing from GFS (wind shear, inverse barometric effect)

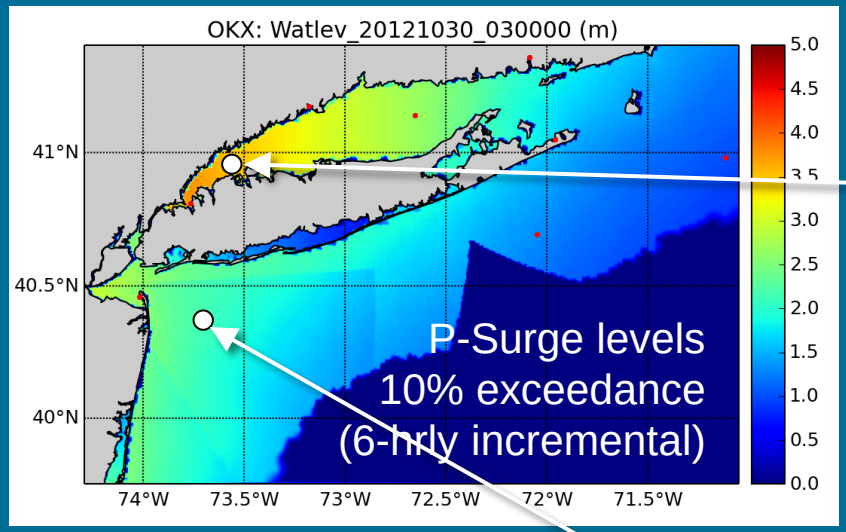


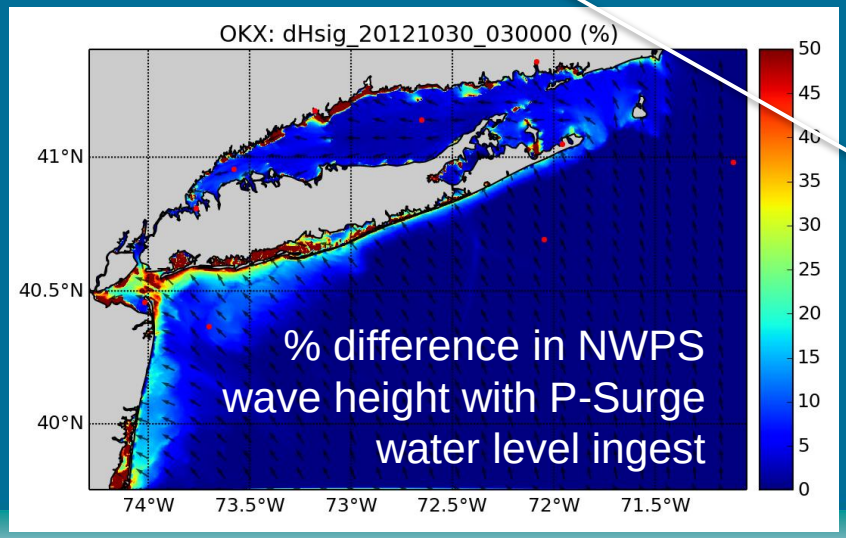


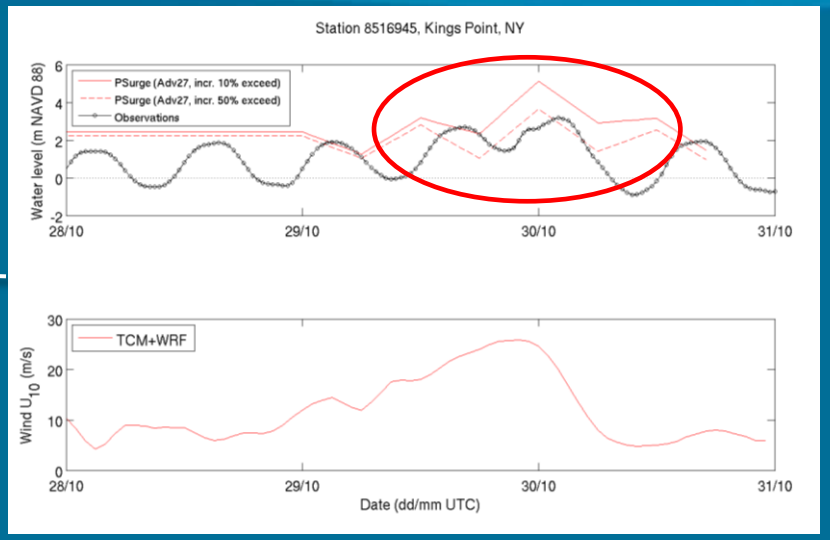


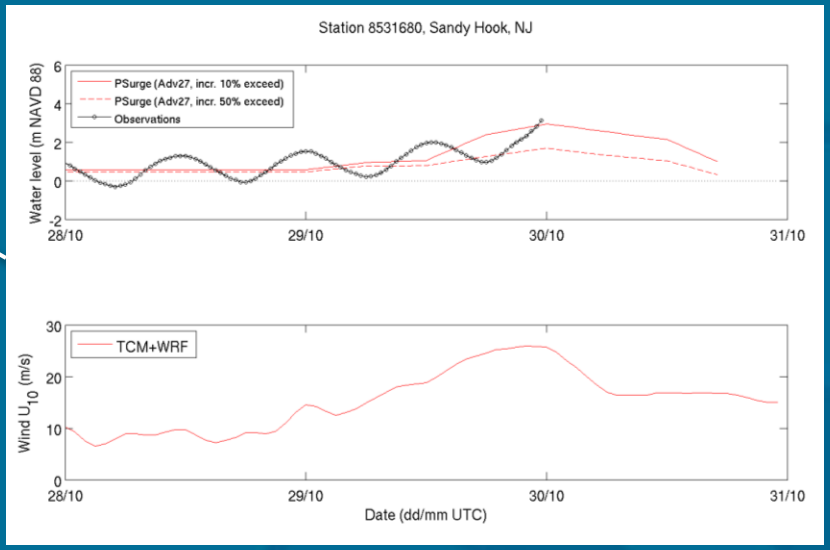
Forcings: Water levels, Tropical

Surge level and tide from 1-hrly P-Surge 2.5

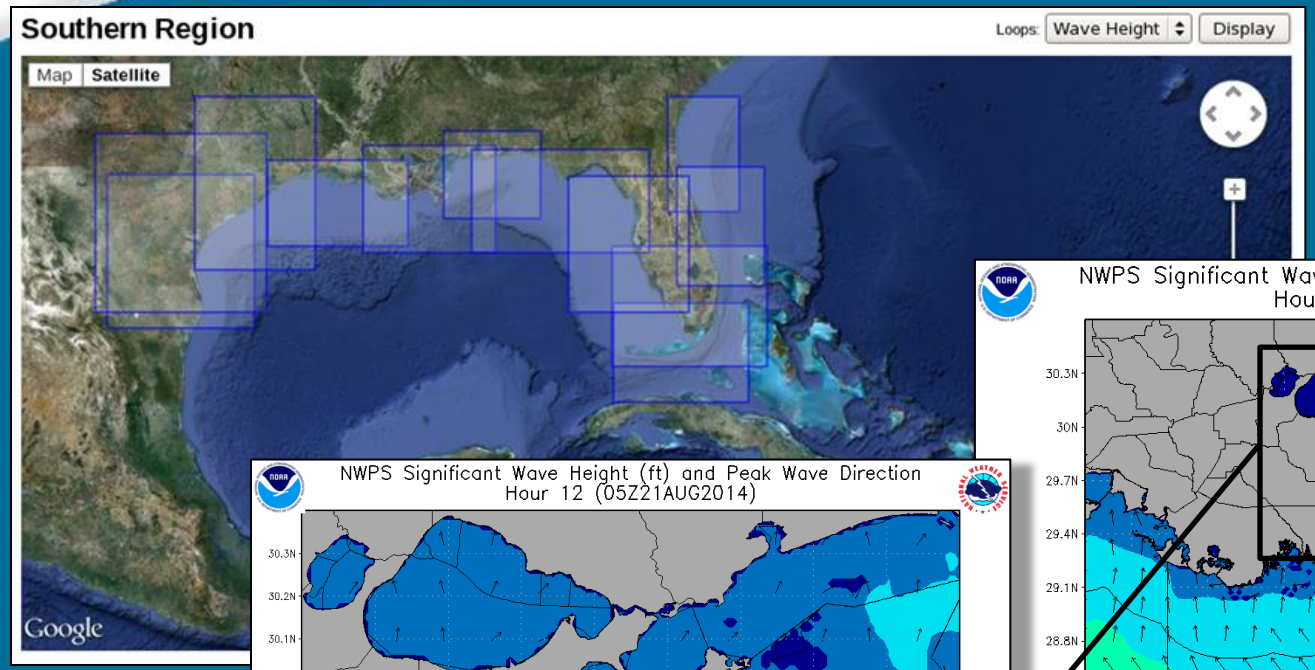




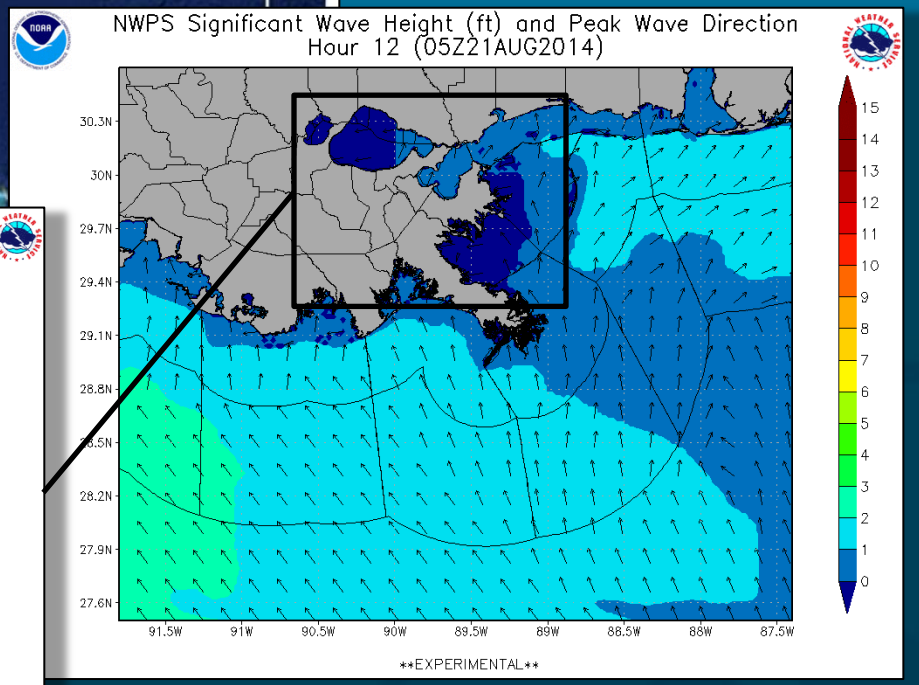


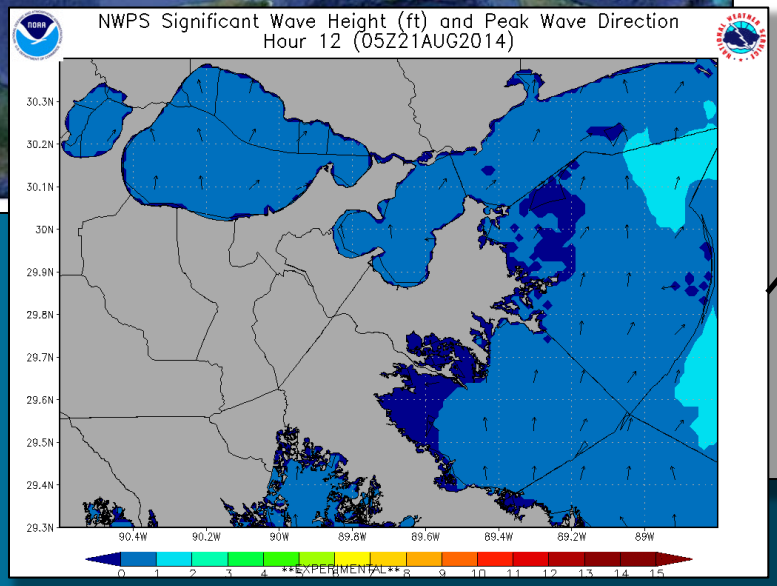


Example output for WFO New Orleans



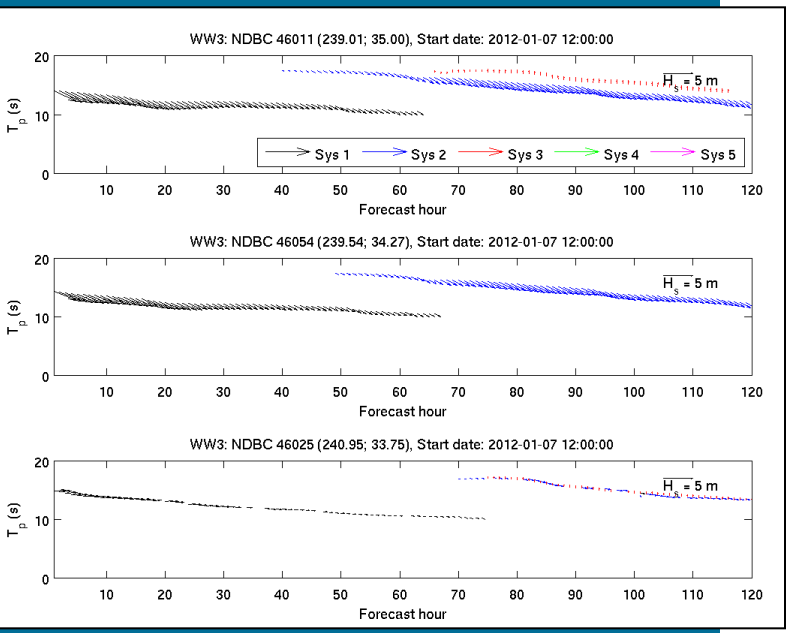
WFO LIX, CG1

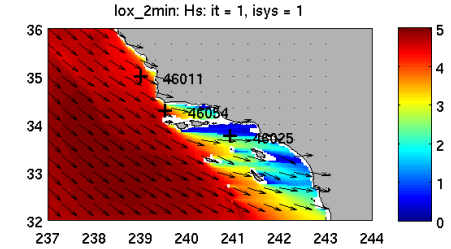


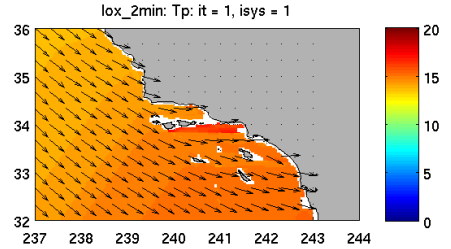


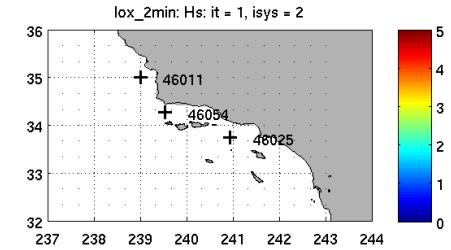
CG2

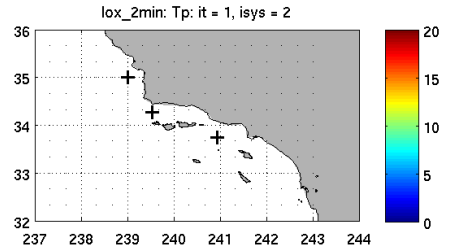
Post-processing: Wave system tracking

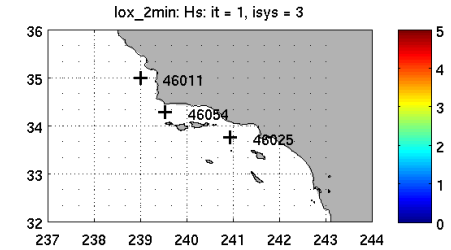


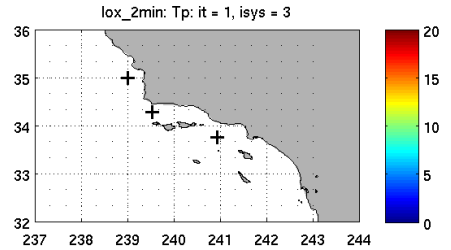


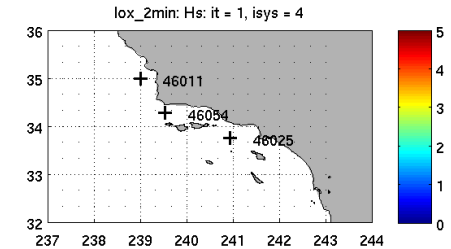


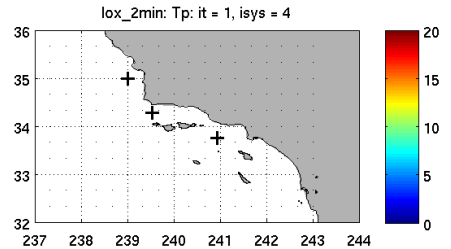


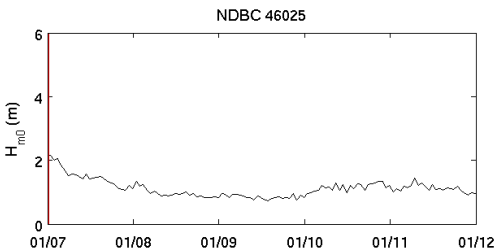


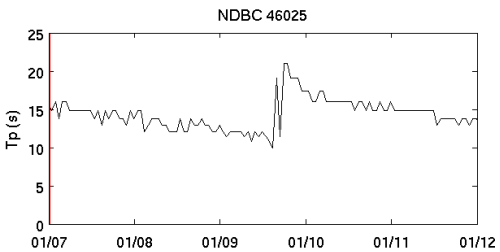




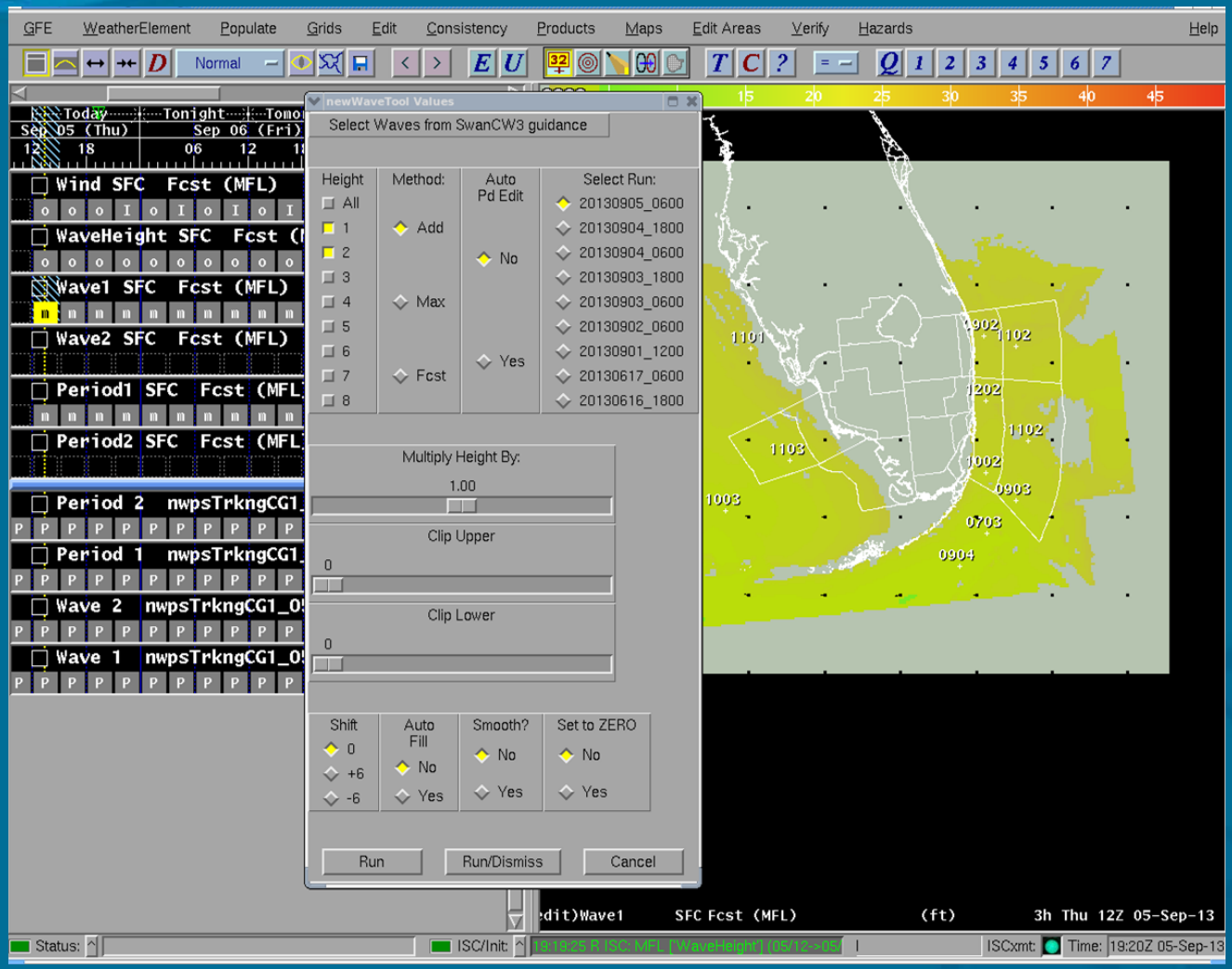




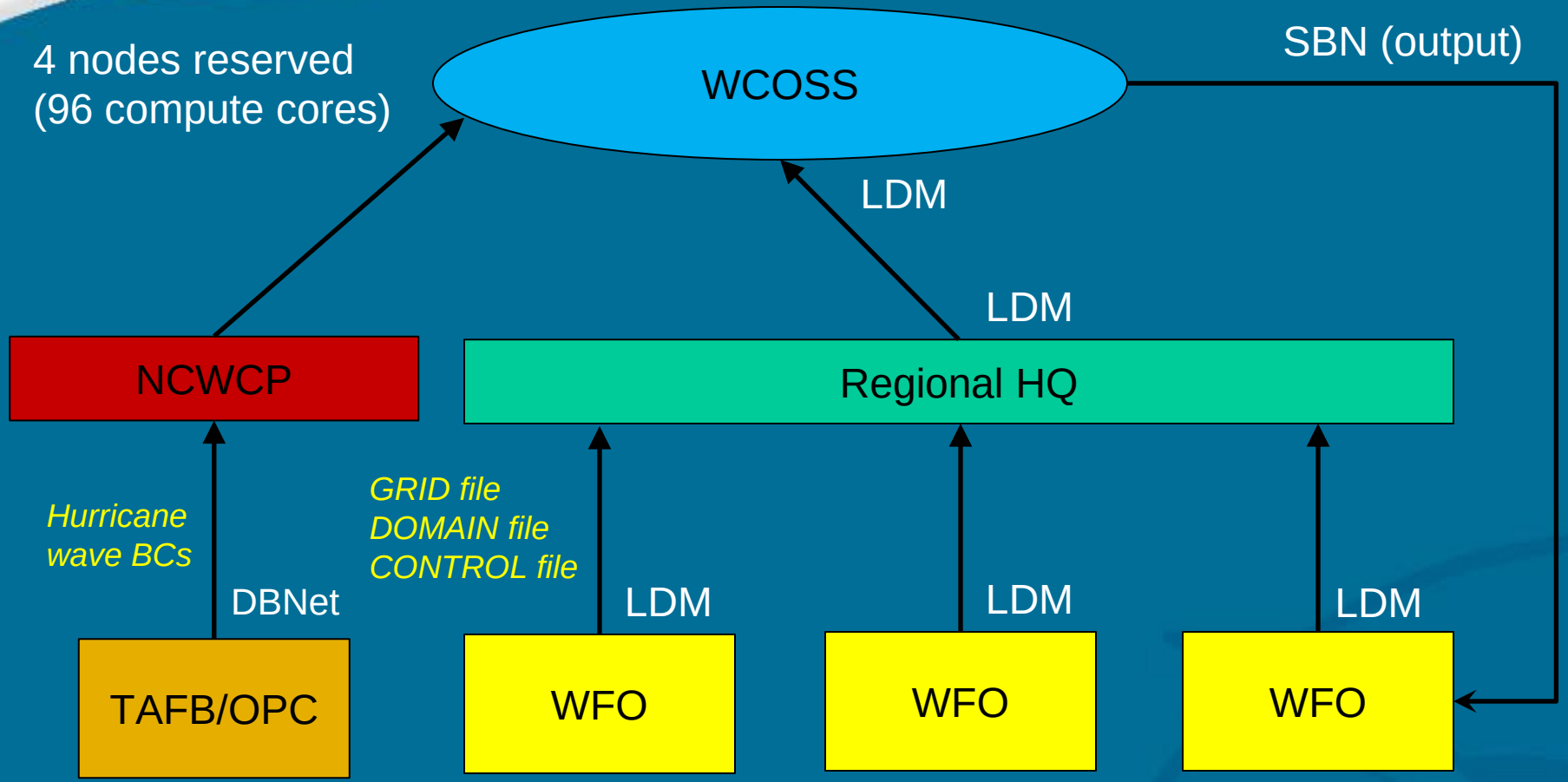




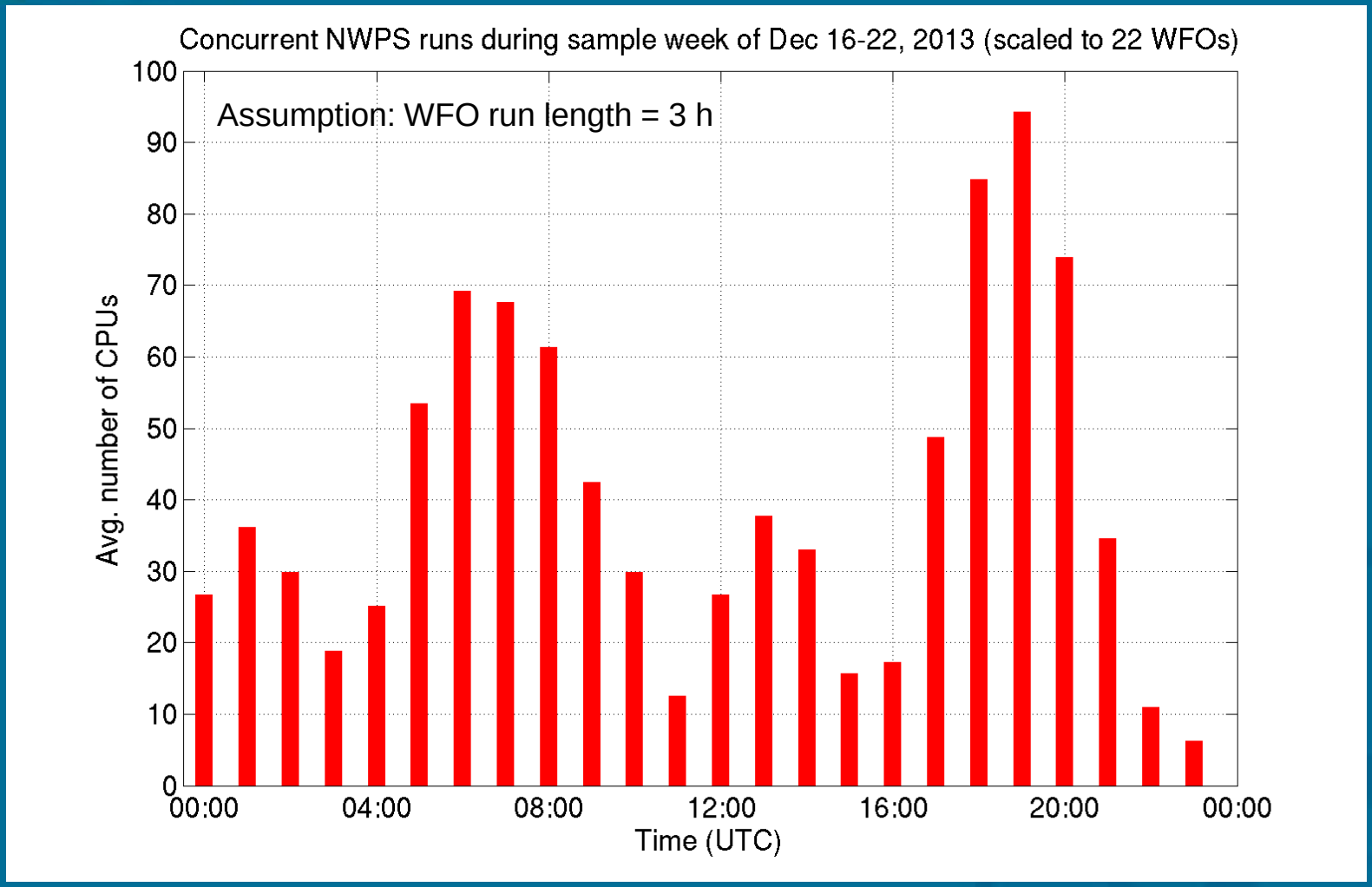
Guidance in GFE for producing forecast



NWPS Architecture (Regional view)

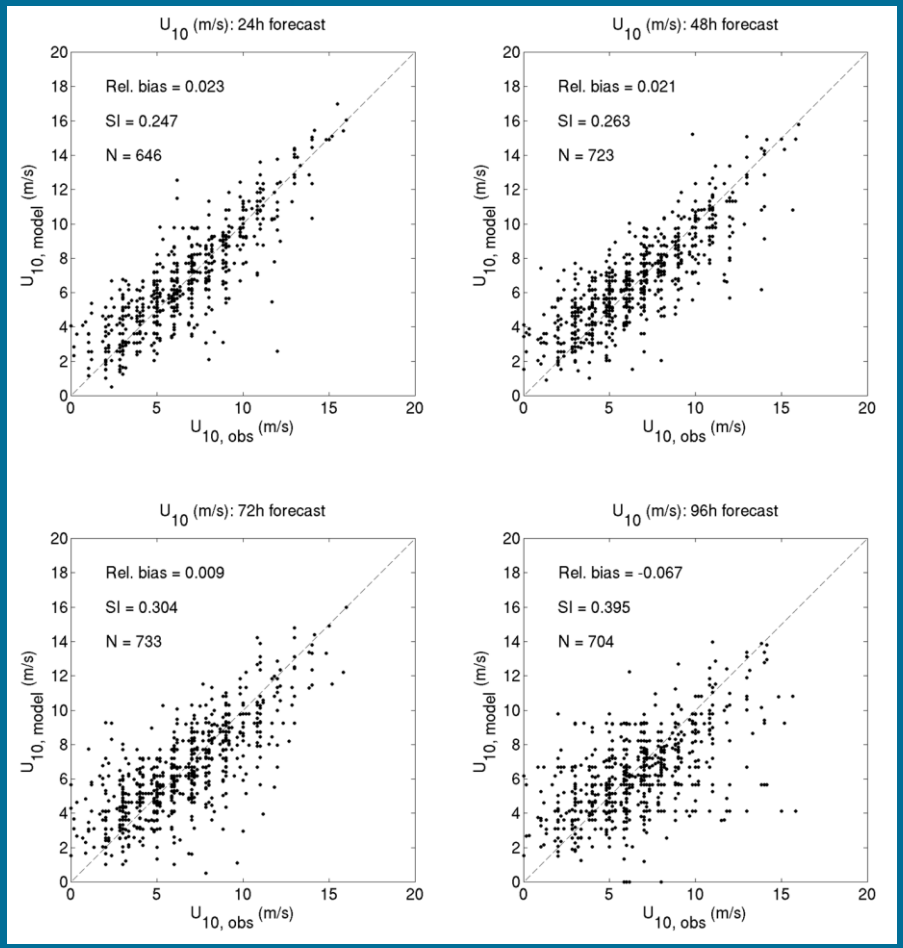


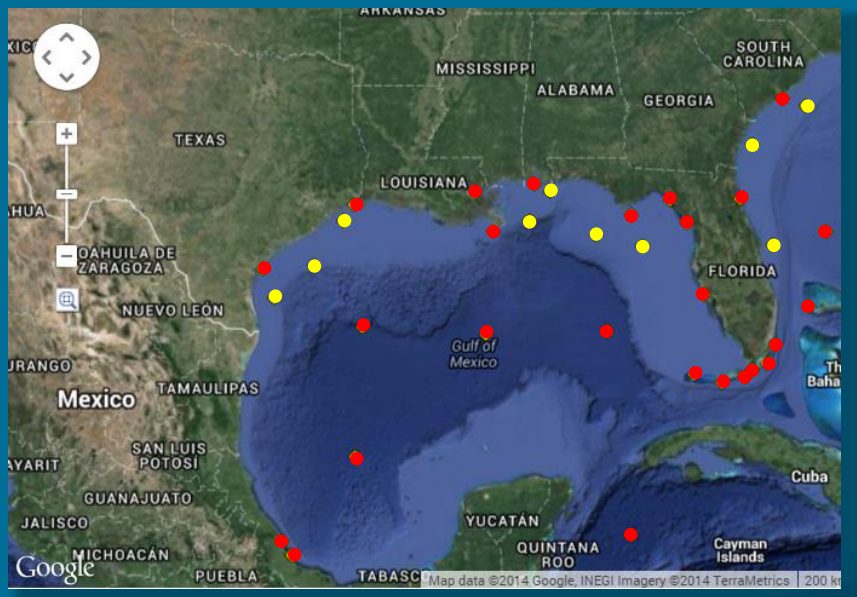
System load analysis



Nearshore model validation

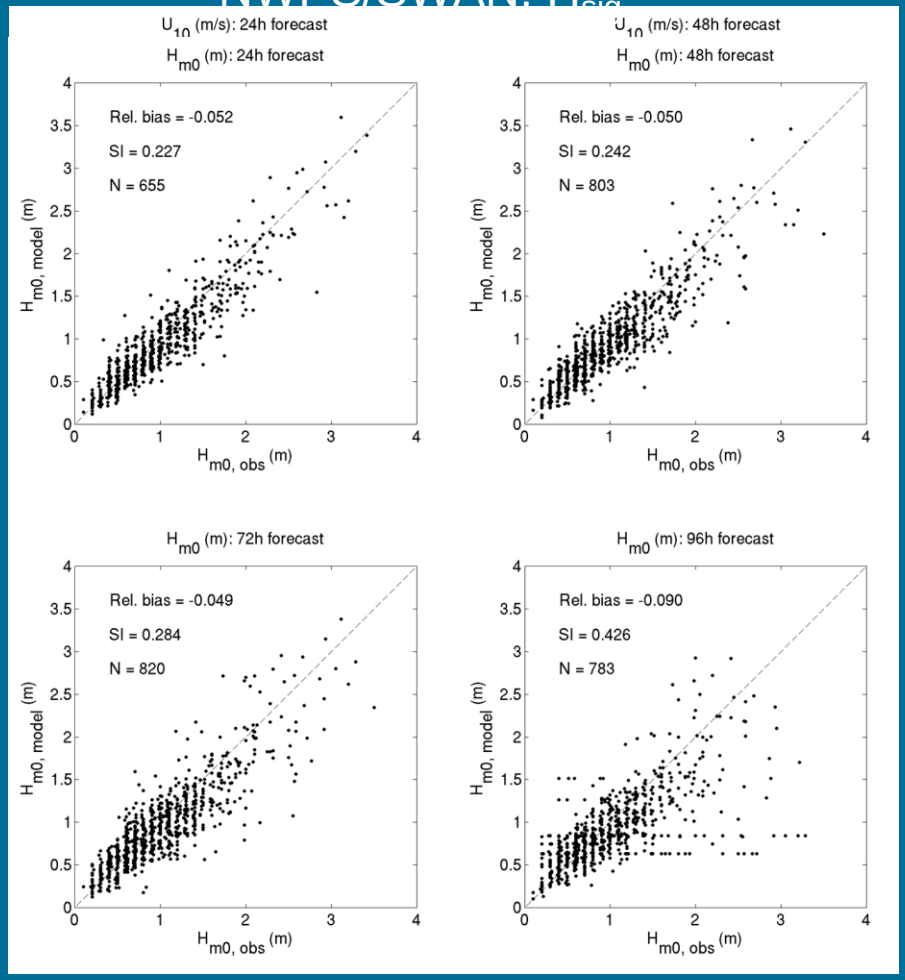
GFE winds: U_{10}

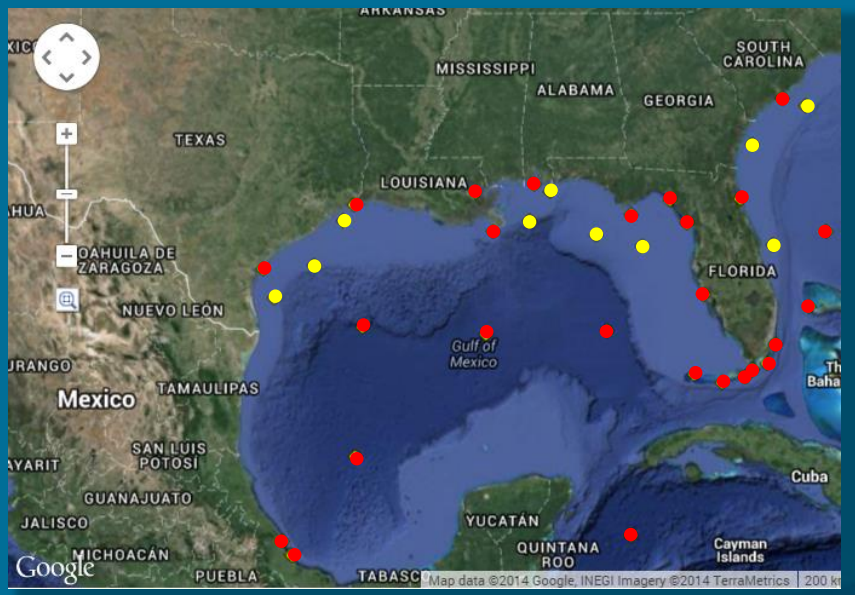




Nearshore model validation

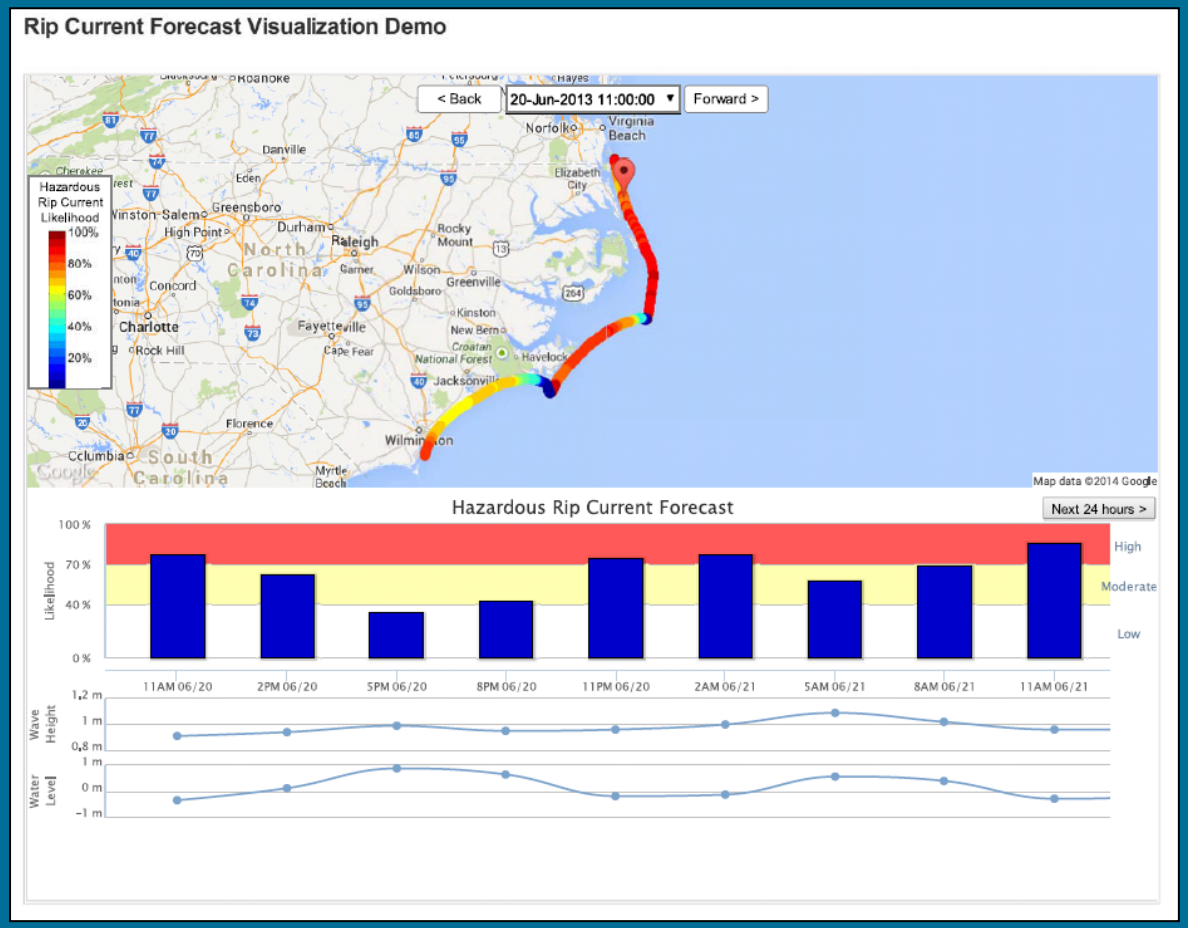
GFE winds: U_{10}
NWPS/SWAN: H_{sig}





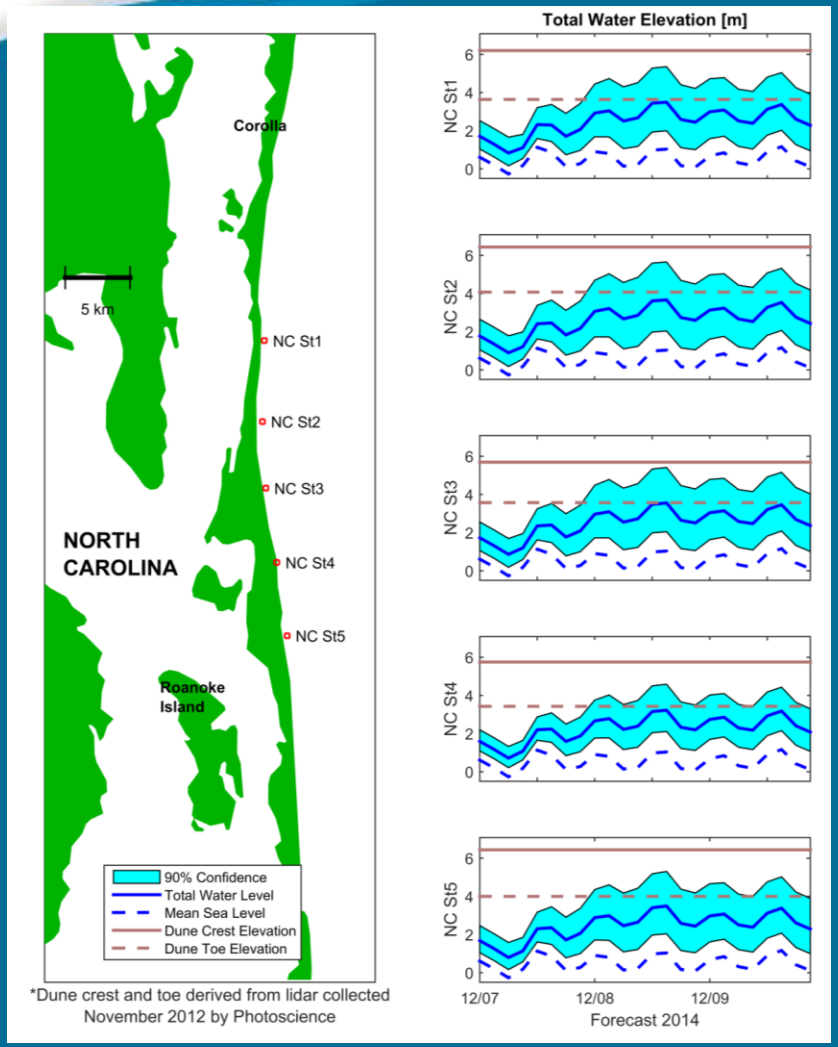
Applications (1): Rip current guidance

WFO Morehead City

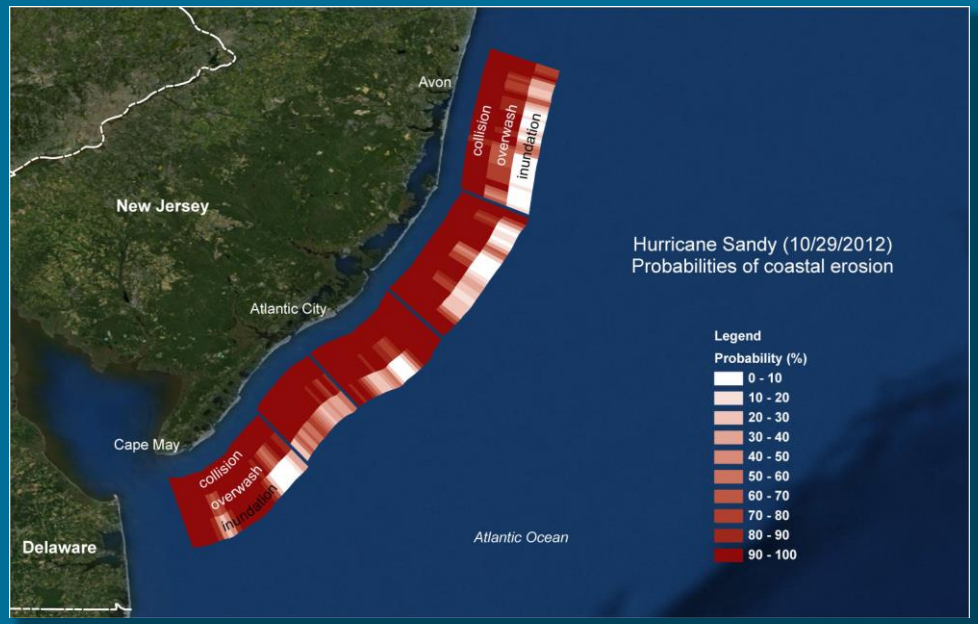


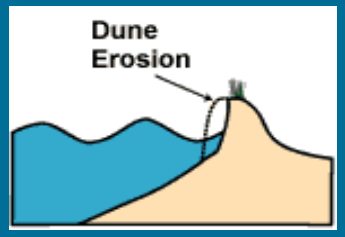
https://sites.google.com/site/ripcurrentforecast/

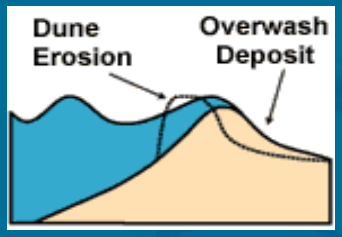
Applications (2): Wave runup guidance



*Dune crest and toe derived from lidar collected November 2012 by Photoscience







WFO
Morehead City

USGS
science for a changing world

Conclusions

1. NWPS: on-demand, high-resolution wave model guidance for coastal WFOs, standardized on the AWIPS 2 baseline.
2. Ensures consistent marine wind and wave guidance.
3. Water level and current ingest (RTOFS, ESTOFS and P-Surge).
4. Wave partitioning as input to gridded wave forecasts.
5. Southern and Eastern Region implementation: FY15Q4 (Sandy Milestone)

Nearshore Wave Prediction System (NWPS) V1.0.0

Project Status as of 03/06/2015

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Project Information and Highlights

Lead: Hendrik Tolman, EMC and Chris Magee, NCO

Scope:

1. Centralized implementation of NWPS that is currently run locally at a number of coastal WFOs.
2. Involves separate implementations for approx. 20 WFOs, using shared basic scripting.
3. Novel on-demand run triggering.

Expected Benefits:

1. Resolution of coastal wave model guidance improved from 4 arc-min (with ww3 multi_1) to at least 1 arc-min.
2. Wave guidance consistent with forecaster-developed wind fields.
3. Improved economy of scale of centralized computing compared to distributed computing.

Y

Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	06/01/15	
Code delivered to NCO	06/01/15	
Technical Information Notice Issued	07/01/15	
CCB approve parallel data feed	07/01/15	
Parallel & IT testing begun in NCO	07/01/15	
Real-Time Evaluation & IT testing Ends	08/01/15	
Management Briefing	08/15/15	
Implementation (2 pilot offices, MFL & BOX)	09/01/15	
Implementation (remaining 20 offices in SR&ER)	09/30/15	

Implementation shifted by 2 quarters to allow for additional development and testing. Sandy implementation milestone (FY15Q4) unaffected.

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Issues/Risks

Issues: Additional computing capacity required; Multiple implementations (each of approx. 20 WFOs).

Risks: Implementation and testing may take longer than usual; On-demand run capability is yet untested.

Mitigation: Funding secured for 4 additional nodes (through Feb 2017). Funding a dedicated SPA for 8 months to work with EMC: An initial testing period of Sept-Nov 2014 is added up-front to test on-demand run capability. Actual implementation and testing occurs during Mar-Jul 2015.

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Finances

Associated Costs:

1) $250,000 - Applied to IBM Task Order 4 to augment WCOSS by 4 nodes (approx 1%). *However, a **continuous (24 h) reservation of 6 nodes** is required for this on-demand system.*
2) $147,180 - To hire dedicated SPA for extended testing and implementation period (Sept-Nov 2014, Mar-Jul 2015)

Funding Sources: Sandy Supplemental; OST development funding.

R	Management Attention Required	Y	Potential Management Attention Needed	G	On Track

WCOSS development & testing schedule